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Octodon degus.

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Octodon Bennett, 1832

Octodon Bennett, 1832:46. Type species *Sciurus degus* Molina, 1782.

CONTEXT AND CONTENT. Order Rodentia, Suborder Hystricognatha, Superfamily Octodontoidea, Family Octodontidae. The genus *Octodon* includes three recent species.

Octodon degus (Molina, 1782)

Degu

Sciurus degus Molina, 1782:303. Type locality Santiago, Chile (called St. Jago by Molina).

Octodon degus Waterhouse, 1848:252.

CONTEXT AND CONTENT. Ellerman (1940) recognized five subspecies, but Thomas (1927) and Yepes (1930) recognized only the lowland *O. d. degus* and a highland race, *O. d. clivorum*. Osgood (1943) reported examining a large series of specimens and finding no geographic variation. Therefore no subspecies are recognized in this treatment.

DIAGNOSIS. The measurements of adult degus (in millimeters) in published reports and in the University of Vermont Museum of Zoology are from: head and body, 250 to 310; tail, 75 to 130; ear from notch, 24 to 32; hind foot, 35 to 38; weight is 170 to 300 g. Anterior upper cheekteeth have only moderate internal indentations and last upper molar has slight fold on inner side (see figure 1). The other two species of *Octodon* are of larger size in all measurements, have anterior upper cheekteeth with deep indentations that nearly touch the opposite side of the tooth, and have the last upper molar with either no fold on the inner side (*O. lunatus*) or a deep fold on the inner side (*O. bridgesi*). The tail of *Octodon degus* is reported to be more "tufted" than it is in either of the other species (Waterhouse, 1844; Wolffsohn, 1927*b*). There is a good description of the species and a color plate in Waterhouse (1848). See also Bennett (1841), Cabrera and Yepes (1960), and Walker *et al.* (1964) for descriptions and illustrations. The early description by Bennett (1832) is quite elaborate and useful.

GENERAL CHARACTERS. The degu has a moderately long, black-tipped tail and soft fur. The fur is less soft than that of either *Octodontomys* or *Octomys*. The ears are well developed, but have little fur on them and are darkly pigmented. The pelage is yellow-brown above and creamy-yellow below. Some individuals are paler below than others. There is a noticeable pale yellow area above and below the eye and often, but not always, a pale band about the neck. The feet are pale gray to white. There are four well-developed toes. The fifth toe is poorly developed and on the forefeet bears a nail instead of a claw. Long stiff "comb-like" bristles project over the claws of the hind feet. The tail is shorter than the head and body, and is less well haired than in either of the other two species of the genus; there is a tuft at the tip (see figure 2).

The dental formula is i 1/1, c 0/0, p 1/1, m 3/3, total 20. The cheekteeth are hypsodont and deeply folded in the midregion. They resemble a figure-of-eight, hence the familial and generic name. The skull has a well-developed infraorbital foramen and an open pterygoid fossa. The bulla are of moderate size, but smaller than in either *Octodontomys* or *Octomys*. The mandible is decidedly hystricognathous (see figure 3).

DISTRIBUTION. The degu is found between Vallenar and Curico on the west slope of the Andes in Chile up to an elevation of 1200 meters (Osgood, 1943). It is confirmed from the provinces of Coquimbo, Aconcagua, Valparaiso, Santiago, and O'Higgins, and is presumed from Atacama in the north and Colchagua and Curico in the south (Cabrera, 1961; Pefaur *et al.*, 1968). This is approximately between 28 and 35 degrees south latitude (see figure 4).

Yepes (1930), Cabrera and Yepes (1960), Walker *et al.* (1964) and Cendrero (1972) all reported that the range of the degu is from central Chile to southern Perú. None of these workers, however, documented their reasons for extending the range northward into Perú. The probable reason for the Peruvian report is a single specimen of a degu collected on the west slope of the Andes at a latitude nearly that of Lima and at an elevation of about 3000 meters (Waterhouse, 1848). Thomas (1927) suggested that this specimen was probably an escaped pet. Pearson (1951) did not mention finding the degu in the highlands of southern Perú. To the south Greer (1965) did not report degus from Malleco Province, which lies between 37.5 and 39 degrees south latitude.

FOSSIL RECORD. *Octodon degus* is known only from recent material. The oldest reported octodontid is *Platypittamys brachyodon* from the Deseadan Oligocene of Patagonia (Wood, 1949; Wood and Patterson, 1959). The postcranial skeleton of *Platypittamys* is remarkably similar to that of *Octodon* (Wood and Patterson, 1959).

FORM. There is little in the literature on the osteology of the degu. Fischer (1940) reported that the degu is less of a burrower than are other octodontids, and has a smaller clavicle and deltoid crest. Both structures are well developed, however. The scapular spine extends from near the vertebral border of the scapula to beyond the level of the tip of the coracoid process, and is a thin, unsupported, fingerlike projection from the midscapular region to the ends of the large acromion and metacromion processes. There is an entepicondyloid foramen in the humerus. The proximal ends of the tibia and fibula are fused. The incus and malleus are not fused (Wood and Patterson, 1959). The auditory bulla is well developed and the paroccipital process hugs the posterior edge and surface. There is a large infraorbital foramen with a ven-

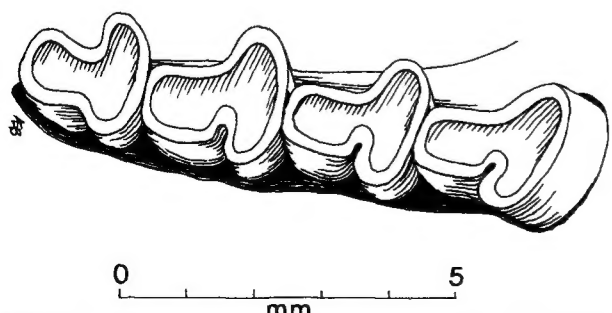

FIGURE 1. View of right upper molar toothrow of *Octodon degus*, anterior at right.

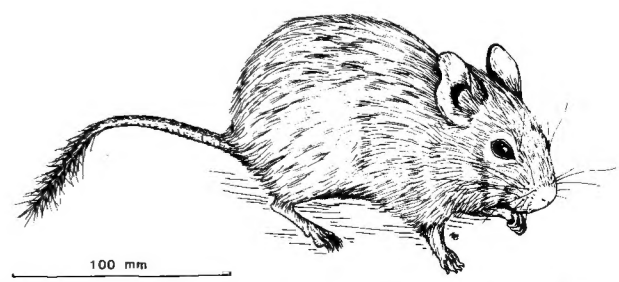

FIGURE 2. External view of an adult *Octodon degus*. Drawn from a living specimen in the University of Vermont laboratory colony by Anne Howland.

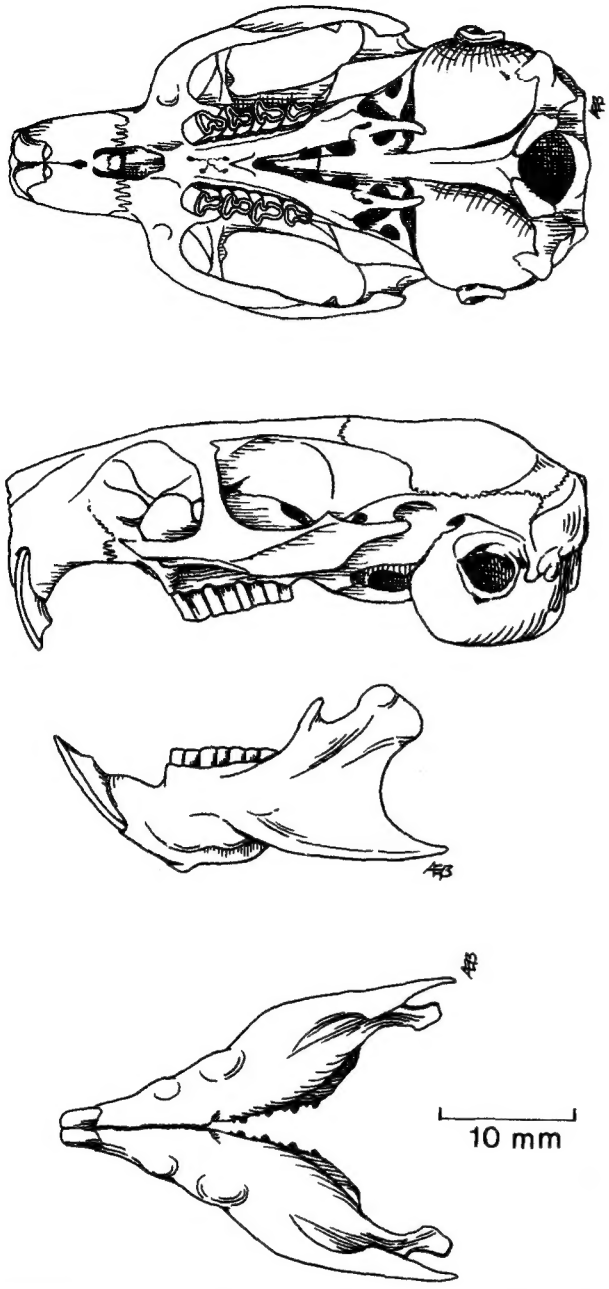

FIGURE 3. Views of the skull and mandible of *Octodon degus* (M-645, male, from the University of Vermont laboratory colony). From top to bottom: ventral view of the skull, lateral view of the skull and mandible, and ventral view of mandible.

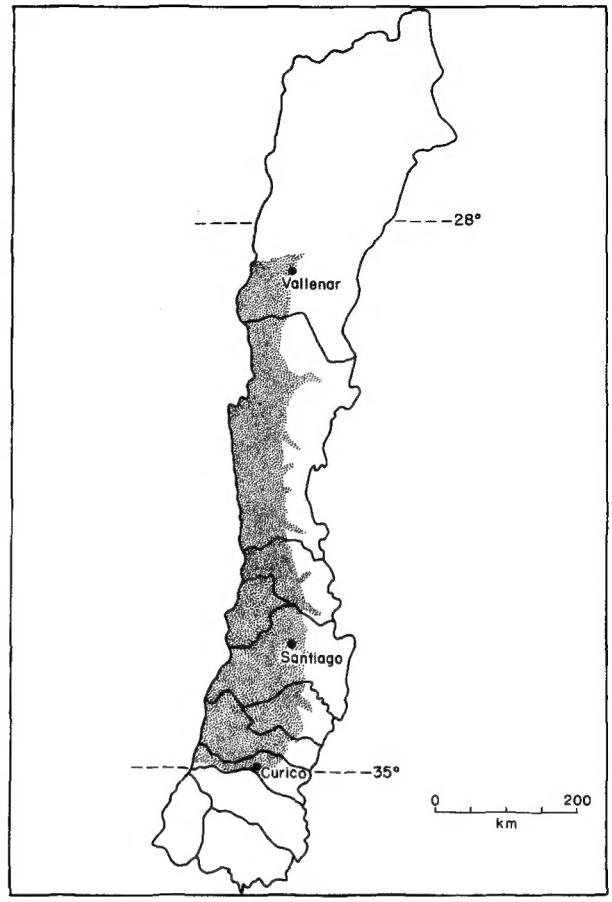

FIGURE 4. Map of central Chile showing the geographic range of *Octodon degus* based on latitude and 1200 meter contours (Osgood, 1943; Pefaur *et al.*, 1968).

tromedial groove. The pterygoid fossa is open, and the tip of the *hamulus pterygoideus* is in contact with the bulla. The mandible is hystricognathous and the two rami are closely joined. The coronoid process is delicate and sharply pointed. The cheekteeth are flat-crowned, hypsodont, and have a single lake with deeply infolded margins. The microstructure of the incisor enamel is multiserial (Wahlert, 1968). The toothrows converge anteriorly.

The musculature of the head, neck, and pectoral appendicular regions was described by Woods (1972). Important myological characteristics are: a complex, four parted *M. cutaneus maximus* in which the anterior part passes to the lateral surface of the shoulder; a *M. scapuloclavicularis*; a *M. scalenus anterior* ventral to the brachial plexus; the lack of a *M. stylohyoideus* in spite of a well developed hyoid apparatus; a *M. mandibulolabialis*; a complex multiparted group of masticatory muscles with the medial masseter passing through the infraorbital foramen and pars reflexa of the superficial masseter passing onto the medial side of the mandible via a groove. The above observations concerning the musculature of the degu are true of all New and Old World hystricognathous rodents, but as a group are absent in all other rodents. The brain was described by Fischer (1940, 1942), and is of the general rodent pattern except for an especially well developed olfactory bulb. The surface of the brain is moderately convoluted, another character that is unusual in rodents other than New and Old World hystricognaths (Beddard, 1892). The circulation to the brain is via the vertebral artery, because the internal carotid and tympanic part of the stapedial arteries have been lost (Bugge, 1971, 1974). The stapedial area blood supply is replaced by the external carotid artery. According to Bugge, the cephalic arteries of New and Old World hystricognathous rodents are identical to those of the degu, with few exceptions. There is both a left and right anterior vena cava (Fischer, 1940). The degu has a double thymus with cervical and mediastinal components. The mediastinal component is multilobed and amorphous, and is morphologically similar to the typical rodent thymus. The cervical component is bilobed and remains active and large for the entire life of the animal, unlike the mediastinal component. The uterus is bicornuate (Fischer, 1940). There are eight mammae, the anterior three pairs being found high on the side of the body in a line between the front and hind limbs (Waterhouse, 1848). Individuals from highland populations of this species may be somewhat larger in body size than those from lowland areas (Thomas, 1927; Wolffsohn, 1927*a*).

Additional, but quite general accounts of the anatomy of the degu are found in Martin (1836) and Tullberg (1899).

FUNCTION. The renal biology of the degu has been investigated by Bellamy and Weir (1972) who reported the following observations. More urine is excreted at night than during the day, especially in males. This pattern suggests that the degu is nocturnal but in the laboratory the general activity levels were maximal during the daylight hours. Fifteen unstressed degus on *ad libidum* water and food had an average urine concentration of 634 m0smoles/liter (B. Fonda, personal communication). The animal should be able to concentrate at

a higher level when deprived of water. Fonda (1975) was able to get degus deprived of water for seven days to concentrate at the level of 4604 m0smoles/liter, and found the relative medullary thickness of the kidney (average of five animals) of the degu to be 6.1. Degus have the unusual ability to concentrate urinary potassium to a greater degree than sodium, and have unusual abilities to retain magnesium (Bellamy and Weir, 1972).

Morrison (1964) and Morrison *et al.* (1963) have investigated adaptations of the degu to live at high altitudes. Their findings indicate that red cells comprise 48.8% of the blood volume and hemoglobin weighs 256 g/liter of blood. Degus do not have the ability to change the concentration of erythrocytes or hemoglobin when exposed to high altitudes. The lack of this ability is characteristic of most rodents. In addition, the degu is sensitive to the amount of oxygen available, and a reduction of the partial pressure of oxygen to three-fourths normal is enough to lower oxygen transport to a critical level. On the basis of the physiological mechanisms so far investigated, the degu is poorly adapted to survive at high altitudes.

There is a tendancy of the degu to develop lens lesions and cataracts. Weir (1970) reported this in her colony at the Wellcome Institute and Boraker and Woods (1975) found it in the Vermont colony. These colonies are of different origin. The same condition has been reported for *Ctenomys*, and in this closely related genus the condition is associated with hyperglycemia, glycosuria, impaired tolerance to glucose load, and reproductive failure, and is clearly associated with diabetes mellitus (Wise *et al.*, 1968, 1972). None of these symptoms were reported by Weir (1970) but these conditions are probably associated with the development of cataracts in the Vermont colony. Because cataracts show up in two separate degu colonies, it is possible that this reflects a natural condition. Darwin (1890) reported that many *Ctenomys brasiliensis* were blind when they were captured. Rothstein and Worgul (1974) reported that the cataracts of degus are the result of disorganization of the meridional rows.

The degu is easy to keep in captivity. Weir (1970), and Boraker and Woods (1975) have commented on their care and management in captivity. Degus can be transferred from cage to cage without preliminary introductions, or later fighting. They do well on lab chow, but reproduce slowly. Some individuals may be aggressive toward humans when handled roughly, however, and when restrained by hand often bite. The degu must be handled with great care because of its habit of spinning like a top and leaving the sheath of its tail behind in the hand of the handler. Weir (1970) reported that animals provided with activity wheels run an average of 4.5 km per day. The normal body temperature of the degu is 37.9°C. There are several large captive colonies of degus, and a number of small colonies. Two of the largest colonies are: University of Vermont, Burlington, Vermont 05401, USA (largest colony in the United States; originally from 20 individual animals snared by a farmer in Lampa, Chile, for Dr. Joel Brown of the Massachusetts Institute of Technology); Instituto de Medicina Experimental del Servico National de Salud, Universidad de Chile, Santiago (under the direction of Dr. Rigoberto Iglesias).

ONTOGENY AND REPRODUCTION. The degu was reported by Bridges (1843) to breed twice a year and to have four to six young at a time. Fulk (1975), however, found the degu in central Chile to breed only in September, but in the northern parts of its range it may have a longer breeding season, extending from November to April. Fulk found the average embryo count of nine females to be 5.3. In captivity, the Wellcome Institute colony bred only in June (Weir, 1970). Females in the colony at the University of Vermont have produced more than one litter per year. The months in which the most births occurred centered around one peak in December and another in July and August. Young have been born in all months of the year, however, with the months of fewest births being April, May, and June. The gestation period is 90 days (Weir, 1970). Implantation occurs by the seventh day after fertilization (Weir, 1970) and there is an unusual attachment of the ectoplacental trophoblast to the maternal tissues (Rowlands, 1972). There is no regular estrous cycle (Weir, 1970). The vagina closes soon after mating and Weir (1970) suggested that the degu may be an induced ovulator. Weir reported that the young in the Wellcome Institute colony were born sparsely furred and with the eyes shut, but animals in the Vermont colony were born with their eyes open and were well furred. The mean litter size for the Vermont colony is 6.8 young. The average weight at birth is 14 g and the neonate animals do not have the ability to control their body temperature. The young grow rapidly and are able to maintain a constant body temperature at day 8 when their average weight is about 20 g (Rosen, 1974). The sex ratio at birth is 100 females to 110 males and the animals are weaned in weeks 4 to 6 (Weir, 1970). Puberty occurs at months 14 to 20 according to Rowlands (1972); however, Wilson and Kleiman (1974) report puberty at day 45. The average weight at first conception is 205 g (Weir, 1970).

In his work on the ontogeny of the homeothermic response, Rosen (1974) reported that the hair on the degu at birth provides a heat saving of 7.78 calories per degree centigrade per hour, and the saving remains constant thereafter. There is a rapid increase in the thermoregulatory ability of animals placed at an ambient temperature of 16.9°C when they reach the size range of 25 to 24 g. Degus in this size range suddenly increase their per gram metabolic rate four times above the level of smaller individuals, suggesting a threshold level of size or physiological development.

ECOLOGY. The degu is the most common mammal of central Chile (Fischer, 1940). Fulk (1975) estimated their density to be 75 per hectare in suitable habitats. Earlier observations by Bennett (1832) and Bridges (1843) indicated that the degu was the most common mammal at that time also. Waterhouse (1848) reported that Darwin saw this species by the hundreds in hedgerows and thickets in central Chile.

The degu is fossorial, diurnal, and colonial (Bennett, 1832; Wolffsohn, 1927*c*). In a field study of the degu, George Fulk (1975) made the following observations concerning their habits. The degu is most active in the morning and late afternoon. The burrow system is elaborate, and there are several chambers. The external opening is often covered with cow dung and sticks. *Abrocoma bennetti* was frequently observed in the same burrow system, and even in the same chamber of the burrow system in one excavation.

The animal feeds on the ground, and will climb into lower branches of small trees and shrubs. The main food sources, as reported by a number of workers, are: herbage about the roots of hedges (Bridges, 1843), the bark of *Cestrum palqui* and *Mimosa cavenia* (Waterhouse, 1848), annuals such as *Erodium cicutarum* in spring and summer, the leaves and bark of shrubs (*Proustia cuneifolia, Atriplex repunda, Acacia caven*) in the autumn and winter (Fulk, 1975), and green grass and the seeds of hawthorn (Fischer, 1940). Wolffsohn (1927*c*) reported that the degu especially likes "teatina," the seeds of thistle and "trevus," and that in old age it will even turn to meat. The animals lay up a store of food in the winter, but are not reported to become dormant (Waterhouse, 1848).

The only predator of the degu reported in the literature is "a species" of horned owl (Bennett, 1832, 1841), but because of the local abundance of the degu it must be preyed upon by a wide variety of other animals. Fulk (1975) reported finding remains of the degu in pellets of the barn owl (*Tyto alba*), the short-eared owl (*Asio flammeus*), both nocturnal predators, and in the diurnal hawk *Buteo fuscescens*.

The animals move outward some distances from their burrows, and carry their tails elevated when running (Bennett, 1832; Bridges, 1843). The habit of not dragging the tail behind them when running was mentioned by Fischer (1940) as important in keeping the tuft of hairs on the tip of the tail from being worn off. Fischer felt that the tuft is of great importance to the animal and that a new tuft will regenerate if the tail is broken off. In the Vermont colony, broken tails did not grow new skin or develop a new tuft. Many animals in the Vermont colony, and in the wild (Fulk, 1975) are without tufts because of a loss of significant parts of their tails. As mentioned earlier, the degu spins like a top when picked up or restrained by the tail.

The degu is found in open areas, and near stone walls and thickets. George Fulk believes that *Octodon lunatus* replaces *O. degus* in regions where thickets are more common, and that *O. bridgeri* inhabits forests.

Pefauer *et al.* (1968) considered the degu to be an important disease and parasite vector. They reviewed the work of Gajardo (1943), Whiting (1946), Tagle *et al.* (1956), and Alvarez (1960, 1961, 1963), and found the degu to be infected with *Linguata serrata, Echinococcus granulosus*, and *Trympanosoma cruzi*, all of which can also infect humans. The importance of this animal as a vector is compounded because of its abundance and because it is frequently encountered near human habitation.

The degu is also an agricultural pest in some areas, where it damages the edible fruits of the prickly pear cactus, wheat fields, vineyards, and orchards (Ipinza *et al.*, 1971; Fulk, 1975).

BEHAVIOR. Wilson and Kleiman (1974) indicated that the degu is colonial, forming extended family groups with possible pair bonding. Degus are precocial, with behavioral patterns such as play (locomotor-rotational movements) and sand-bathing developing rapidly during the second week after birth. Play is almost exclusively family oriented and involves frequent naso-body contact. Fulk (1975) reported that adults carry grass to the nest for the young animals to feed on. He further observed that mounds of sticks, stones, and cow dung are conspicuous in all colonies he investigated and that the adults immediately carried material to a mound after chasing off an intruder. Fulk feels that the mounds may serve to signal ownership of a nesting site. An extensive discussion of behavioral patterns in degus is found in Kleiman (1974).

GENETICS. The diploid chromosome number of 25 juvenile and adult degus from the colony at Santiago, Chile was reported by Fernández (1966, 1968) to be 58. There is no difference between the chromosome number of males and females. George and Weir (1972), working on animals from the Wellcome Institute, confirmed that the diploid number is 58. These animals were originally from the Santiago colony. Fernández (1968) and George and Weir (1972) differ on the nature of the chromosomes with the latter workers finding fewer pairs of acrocentrics (none) and subacrocentrics (three). Fernández (1966, 1968) also reported that the Y-chromosome of the degu is unusually large, but George and Weir (1972) did not find this to be true in the animals they investigated. The Wellcome Institute animals have a calculated NF value of 116, an average chiasmata per bivalent of 1.6, and a recombination index of 73, which is high for rodents (George and Weir, 1972).

REMARKS. The origin of octodontids and other hystricognathous South American rodents is unknown and the object of considerable speculation (Landry, 1957*a*; Wood and Patterson, 1959, 1970; Lavocat, 1969; Hershkovitz, 1972; Woods, 1972; Wood, 1973). The work of Landry (1957*a*) indicated that octodontids arose late in the tertiary from a hypsodont myocastorid form. He rejected the idea that *Platypittamys* is an octodontid, preferring to classify this taxon as an erethizontid. Wood and Patterson (1959), on the other hand, believed that *Platypittamys* is an octodontid and that the primitive Octodontidae were ancestral to all Caviomorpha with the possible exception of the Erethizontidae. We believe that Wood and Patterson are correct except that we would prefer to refer to the Caviomorpha and Erethizontidae as separate infraorders under the suborder Hystricognatha.

The degu was once considered closely related to the African rock rat, *Petromus typicus*, and both species were placed in the family Octodontidae (Ellerman, 1940; Simpson, 1945; Ellerman *et al.* 1953). Landry (1957*b*) reviewed the reasons for this and concluded that "the impressive morphological similarity between *Petromus* and the South American forms that has so long haunted the literature on hystricomorph rodents does not exist" (pp. 359–360). On the basis of the comparative myology of *Octodon* and *Petromus* (Woods, 1972), these two genera are not similar enough to be grouped at the family level, but clearly should be grouped together at the subordinal level.

In addition to degu, common names in local use for *Octodon degus* include chozchoris, rata de las cercas, ratón de tapias, ratón cola de trompeta, bori, and Cuming's octodon.

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